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REDUCING EVAPORATION FROM WATER STORAGES
BY MEANS OF MONOMOLECULAR FILMS

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REDUCING EVAPORATION FROM WATER STORAGE BY
MEANS OF MONOMOLECULAR FILMS.

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1. Each year, in inland Australia, countless millions of gallons of valuable water are lost by evaporation. Lack of fresh water is a serious problem in the dry interior, and it is virtually impossible to obtain more by such techniques as rain making, for there are few occasions on which rain-bearing clouds appear. Consequently, if anything is to be done to improve the supply, some means must be found for conserving the water already available.

2. An attack on this conservation problem was begun by the Division of Physical Chemistry of the Commonwealth Scientific and Industrial Research Organization (C.S.I.R.O.) a few years ago when W.W. Mansfield developed a method of reducing evaporation. The basic idea has been known for some time but Mansfield first formulated the many problems to be overcome before a really practical scheme (rather than just a laboratory technique) could be achieved. The process involved spreading an extremely thin chemical film over the water surface: pellets of a solid chemical, cetyl alcohol, were stored in a floating gauze raft moored on the water, and from these the protective layer spontaneously spread out.

3. On small farm dams evaporation losses were sometimes reduced by more than 30%. However, this "raft" process was only partially successful, for a variety of unexpected difficulties arose:- some of the commercial rafts were of poor quality and were easily damaged, ducks often sat on them and pushed them so low in the water that they could not work properly, algae sometimes grew over the raft gauzes and clogged them completely. Many unfortunate things of this nature occurred, so much so that C.S.I.R.O. no longer recommends the process for farm dams. Nevertheless, despite the difficulties mentioned, Mansfield's pioneering work showed clearly that under appropriate conditions cetyl alcohol films could be very effective in reducing evaporation from open water storages.

4. A new method has now been developed for treating large reservoirs $\frac{1}{2}$ sq. mile or more in area. The surface is dusted from a boat with a fine, dry, cetyl alcohol powder, which then spreads rapidly to give effective cover. The treated water is easily recognised for the film produced reduces the waves and ripples, and many striking reflection effects can be observed on a fully covered surface. Cetyl alcohol, is, of course, quite harmless to animals, birds, and even to fish, and the quality of the water is not affected.

5. The film is sensitive to wind and will withstand only light breezes before being blown back. Nevertheless, it is rarely completely lost and traces of cetyl alcohol nearly always remain upon the water surface, even if the winds are strong. When the wind dies, complete cover is often formed again very quickly.

6. In the initial experiments the powder was distributed with an agricultural duster. However, difficulties were experienced in storing and handling the finely divided cetyl alcohol, which is waxy in nature, and this led to the invention of an ingenious grinding machine by Mr. C.S. Robertson of the Broken Hill Water Board, working in collaboration with the C.S.I.R.O. Solid blocks of cetyl alcohol are fed on to a rotating wire brush which revolves at high speed and shreds the material to a fine dust: this is then blown through a delivery tube by a fan, and out on to the water surface. In the early stages of treatment, daily applications are advisable, but as it is possible to cover an area of about 1 sq. mile in roughly an hour, the time involved is not excessive.

7. The method has been tested extensively in the last two years, and it appears to be highly successful in calm weather, when evaporative losses are reduced by about 50%; however, in windy conditions the savings are smaller, the efficiency of the present process falling off quite rapidly with persistent winds in excess of 5 m.p.h. This is because the cetyl alcohol film is broken up and blown bodily across the water surface, together with the excess powder needed for film formation. On large areas of water an appreciable time elapses before a major portion of the film is dissipated in this way, but on small farm dams it happens quite quickly, and thus the process is not recommended for these.

8. The effect of wind is a serious problem and it is hoped that means will ultimately be found for supplementing the addition of cetyl alcohol dust from a series of automatic wind-driven dispensers. Nevertheless, despite its limitation, the present method is still economic, for under favourable conditions the cost of treating a large reservoir is of the order of 1d. per thousand gallons of water saved. Full details of the process have been published.^{1,2,3}

9. In an earlier method, developed by Mansfield for treating large reservoirs, a concentrated solution of cetyl alcohol in a volatile solvent was introduced to the water surface from a series of drip-feed dispensers on the banks.^{4,5} This proved successful over a short test period, but the technique has certain disadvantages: full details of the results obtained will be published in due course.

¹ Vines, R.G. Reducing evaporation with cetyl alcohol films: a new method of treating large water storages. Aust. J. Appl. Sci. 11, 200 (1960).

² Vines, R.G. Recent development in the control of water evaporation Wool Technology and Sheep Breeding (Australia) 7, 137 (1960).

³ Vines, R.G. Evaporation control: a method of treating large water storages from Retardation of Evaporation by Monolayers, Academic Press, New York, 137 (1962).

⁴ Sutherland, K.L. Economic methods of controlling evaporation of water. Research 10, 198 (1957).

⁵ Vines, R.G. and Lugton, F.D. The spreading of surface films from solutions of cetyl alcohol. Aust. J. Appl. Sci. 11, 497 (1960).

BIBLIOGRAPHY

10. All scientific publications from C.S.I.R.O. on evaporation control are listed below. The basic investigations described in these publications range over a wide field, and include studies of the spreading of monolayers, the phase behaviour of solid cetyl alcohol and the action of wind and waves on a water surface.

Mansfield, W.W. Influence of monolayers on the natural rate of evaporation of water, Nature, 175, 247 (1955)., c.f. Nature, 172 1101 (1953).

Mansfield, W.W. The use of hexadecanol for reservoir evaporation control, Proc. 1st Int. Conf. on Reservoir Evaporation Control, San Antonio, Texas, 13 (1956).

Mansfield, W.W. Reduction of evaporation of stored water, Arid Zone Research, Climatology & Micro-climatology, Proc. Canberra Symposium 61. (Oct. 1956).

Mansfield, W.W. The influence of monolayers on evaporation from water storages -

I. The potential performance of monolayers of cetyl alcohol.

Aust. J. Appl. Sci. 9, 245 (1958).

II. Evaporation and seepage from water storages.

Aust. J. Appl. Sci. 10, 65 (1959).

III. The action of wind, wave and dust upon monolayers.

Aust. J. Appl. Sci. 10, 73 (1959).

IV. The spreading of monolayers from solids.

Aust. J. Chem. 12 382 (1959).

Mansfield, W.W. Aspects of evaporation control, from Retardation of Evaporation by Monolayers, Academic Press, New York, p.133 (1962)

Stewart, F.H.C. Phase relationships and spreading behaviour of cetyl alcohol mixtures, Aust. J. Appl. Sci. 11, 157 (1960).

Stewart, F.H.C. The preparation of some surface active alcohols containing the anthracene nucleus, Aust. J. Chem. 13, 478 (1960).

Stewart, F.H.C. Unimolecular films from certain anthracene derivatives, Aust. J. Chem. 14, 57 (1961).

Sutherland, K.L. Economic methods of controlling evaporation of water, Research 10, 198 (1957).

Sutherland, K.L. and Linton, M. Solution of oxygen through a monolayer, Aust. J. Appl. Sci. 9, 18 (1958).

Vines, R.G. Evaporation control - the Mansfield process, Wool Technology & Sheep Breeding (Australia), 5, 51 (1958).

Vines R.G. and Meakins, R.J. Phase transformation in commercial cetyl alcohols for water conservation, Aust. J. Appl. Sci. 10, 190 (1959).

Vines, R.G. Wind stress on a water surface, Quart. J. Roy. Met. Soc. 85, 159 (1959).

Vines, R.G. Anti evaporation tests at Umberumberka. the Conveyor, Zinc Corp. Broken Hill, 10 (1959).

Vines, R.G. Reducing evaporation with cetyl alcohol films: a new method of treating large water storages, Aust. J. Appl. Sci. 11, 200 (1960)

Vines R.G. The damping of water waves by surface films, Aust. J. Phys. 13, 43 (1960)

Vines, R.G. Recent developments in the control of water evaporation, Wool Technology and Sheep Breeding (Australia) 7, 137 (1960).

Vines, R.G. Evaporation control: a method of treating large water storages from Retardation of Evaporation by Monolayers, Academic Press, New York, p. 137 (1962).

Molecular Films Aid Water Conservation, Chem. Eng. News, 38 (No.39), 1 (1960).

